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An Assessment of Industrial Capacity Utilization in African Countries: A Methodological Framework for the Measurement of Excess Capacity

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I. INTRODUCTION

1. The industrialisation process in African countries has failed to yield the dynamic forces required for the structural transformation of their economies so as to attain a self-reliant and self-sustained growth and development.[1/] Comparatively, the African region is a late starter on the road towards industrialization and the region remains less industrialized than the other third world regions, Asia and Latin America. The African economic evironment is still dominated by agriculture, other primary production and associated tertiary activities which have been adversely affected by recurrent drought and increased desertification, undoing the meagre indusrial progress made over the past two decades.

2. One of the major obstacles to accelerated industrialization in developing African countries is that investment capital is scarce but, paradoxically, capital is being wasted in manufacturing industries through capacity underutilization. The decline of external resource flows to African countries combined with drastic cuts in export earnings have forced many to borrow at exorbitant interest rates on the international financial markets in order to finance investment programmes, including those in the manufacturing sector. Real interest rates are a principal component of capital cost, and their threefold increase over the past three decades has had a severe impact on new industrial investment in African countries.

3. It is most important to harness and fully utilize the existing capital stock in Africa. Over the past decade, an increasing number of manufacturing establishments have been operating far below installed capacity. The acute excess of capacity in the African Region threatens to undermine sustained industrial growth in developing Africa, especially in Sub-Saharan Africa. Industry managers and development planners are quite aware of the extent of this under-utilization and its effects on progress towards national development targets for growth of output, employment creation, etc., but, disturbingly, neither Governments nor industrialists have set up appropriate machinery to reduce this waste of capital.

I.1. Background

4. It was in recognition of these problems that the Third Session of the Joint Conference of African Planners, Statisticians and Demographers[2/] recommended the ECA secretariat to carry out preliminary research on the measurement of excess capacity and the related statistical data requirements

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1/ ECA and Africa's development, 1983-2000: a preliminary perspective study, Addis Ababa, April 1983, page 11.

2/ UNECA: "The Report of the Third Session of the Joint Conference of African Planners, Statisticians and Demographers" Addis Ababa, 29 March, 1984, E/ECA/CM.10/24.

so as to enable African Governments to design industrial plans and investment programmes that treated excess capacity as an internal problem and introduced basic measures to reduce the waste substantially.

2. Objectives and organisation of the study

5. The study has been carried out as a desk research project with very limited empirical investigation, although evidence of excess capacity based on fragmentary data for certain countries will be provided to illustrate the magnitude of the problem. The main aim of the paper is to demonstrate the extent of excess capacity in manufacturing industries in developing Africa and to propose a methodological framework for the measurement of industrial capacity under-utilization.

6. The paper is structured as follows: In section II, trends in industrial performance are analysed with emphasis on the structural characteristics of the manufacturing sector, industrial policies and strategies, against the background of socio-economic decline in the African region. Section III examines the kinds and causes of excess capacity and their impact on African economies. This is followed in section IV by a review of the conceptual issues and problems in measuring excess capacity in the context of both micro- and macro-capacity.[3/] An attempt is made in section V to propose an adaptable methodological framework for measuring excess capacity in the African manufacturing sector and the statistical data and other technical information requirements for the approach. The last section highlights the major causes of excess capacity in Africa and the areas on which Planners, Statisticians and/or the managers of industrial enterprises should concentrate in order to avoid wasting capital and other factor inputs and thereby increase manufacturing output in the region.

II. TRENDS IN INDUSTRIAL DEVELOPMENT IN AFRICA

II.1. Africa's socio-economic conditions

7. Such diverse measures of growth and development performance as per capita GDP, share of primary activities in total production, illiteracy rates, level of mortality and basic health conditions show Africa to have more countries still in the early phase of development than any other region. In fact, 26 out of 36 'least developed' countires (LDCs) in the world are in Africa and account for about 33 per cent of the population in the region, with a per capita GDP in 1983 of about US$221 (at 1980 market prices)[4/].

3/ The study concentrates on Micro-capacity i.e. measuring excess capacity at the plant level in the manufacturing sector.

4/ For the same year per capita GDP for developing Africa as a whole was estimated at US$ 631 (at 1980 market prices). See: Survey of Econopmic and Social Conditions in Africa, 1983-1984 - E/ECA/CM.11/16.

8. At the end of the 1970s, Africa recorded an annual growth rate of only 1.3 per cent and since the beginning of the 1980s the region has not registered any positive growth. On the other hand, annual population growth accelerated at a rate of 2.5 per cent. As a result of these trends per capita income in the region as a whole was down by 10.2 per cent in 1984 from its 1980 level.

9. The performance of the agricultural sector was particularly dismal, mainly because of the severe drought which struck a large segment of the African population. Between 1980-1984, the sector grew by less than 2 per cent annually and with an increasing population growth rate, this meant a continued decline in per capita agricultural output. This poor performance of the agricultural sector, combined with acute balance-of-payment difficulties and the resultant shortage of foreign exchange earnings to finance essential inputs and spare parts, adversely affected the manufacturing sector, and left industries operating at below 50 per cent of installed capacity.

II.2. Industrial structure and manufacturing sector performance

10. Africa,s industrial sector is not only small but characterized by an inflexible structure, and concentrated in a few countries, notably Nigeria, Egypt, Algeria, Zimbabwe and Morocco, which together account for over half of manufacturing value added (MVA) in developing Africa. Apart from a narrow range of intermediate goods, the sector chiefly produces consumer goods, doing relatively little processing and semi-processing of mineral and agricultural raw mateials, mainly for export. Otherwise, small-scale activities predominate, most of them taking place in very small, labour-intensive production units using rudimentary technologies to make artisan and handicraft products in predominantly manual operations, and semi-skilled marginally employed producers of crude consumer goods.

Table 1: Share of selected industries in manufacturing value added
(percentage at constant 1975 prices)

	ISIC Category[a/]	45 African Developing countries	Algeria, Egypt, Morocco and Nigeria		
		1975	1960	1970	1977
Food, beverage and tobacco	31	31.3	33.2	20.5	24.1
Textile wearing apparels and leather industries	321	20.0	25.0	24.8	21.4
Wood producing including furniture	33	4.2	4.7	3.5	3.0
Paper and paper products/ printing and publishing	34	4.9	5.7	6.0	4.8
Chemicals etc. [b/]	35	15.9	12.9	15.8	19.1
Non-metallic mineral products [c/]	36	4.9	4.8	5.1	5.1
Basic metal industries	37	4.9	4.8	5.1	5.1
Metal products, machinery and equipments	38	12.6	9.2	13.7	10.5
Other manufactures	39	1.3	0.2	0.4	0.3
		100.0	00.2	100.0	100.0

Source: ECA and UNIDO Secretariats

a/ International Standard Industrial Classification (ISIC) of all Economic Activities. Two-digit categories are divisions and three-digit categories are major groups.

b/ Manufacture of chemical, petroleum and plastic products.

c/ Except products of petroleum and coal.

11. As illustrated by the table above the manufacturing sector in Africa is dominated by enterprises producing simple import substitutes, largely food, beverages and tobacco, followed by textiles and clothing. These two subsectors account for over 50 per cent of total manufacturing output in relatively large economies such as Algeria, Egypt, Nigeria and Morocco. Heavy industries including metal working, electrical and chemical industries, are relatively few and concentrated in the large economies, especially the oil-exporting countries of the region.

12. Actual performance in the manufacturing sector has fallen far below the targets set in the programme for the Industrial Development Decade for Africa (IDDA). The average annual growth rate of manufacturing output between 1980 and 1984 was around 1.5 per cent, and in 1984, the sector registered a decline of 1 per cent for developing Africa as a whole. As shown in Table 2, manufacturing output in 1980 was only 8.2 per cent of GDP for the region as whole. The ratio in 1984 ranged from 12.3 per cent in East and Southern Africa to 5.9 per cent in West Africa. In North Africa the ratio was only 10.6 per cent because of the importance of oil production, but in absolute terms the subregion accounted for 50.6 per cent of the regional value added in manufacturing industries. Despite these variations in the ratio among subregions and economic groupings, a common conclusion to be drawn is that throughout the region the manufacturing sector has not played its expected role in the economy.

Table 2: Developing Africa's manufacturing output as a proportion of gross domestic product, by subregion and for economic groupings

	No. of countries	Percentage of GDP in 1980	1983	1984
Developing Africa		8.2	9.0	8.9
North Africa	6	8.9	10.1	10.6
West Africa	16	6.5	6.5	5.9
Central Africa	11	6.2	7.7	7.9
East and Southern Africa	17	13.5	12.7	12.3
Oil-exporting countries	9	6.4	7.7	7.7
Non-oil-exporting countries	41	11.7	11.2	11.1
Sub-Saharan countries	45	7.7	8.1	7.7
Least developed countries	26	8.2	7.6	7.4

Source: ECA Secretariat calculations based on national income accounts.

II.3 Evaluation of Industrial Policies and Strategies

13. Africa's industrialization has been quasi-autocentric, with much emphasis on import-substitution policies and strategies. Import-substitution is attractive because it meets a demand that is already known and can be measured by existing imports. While the strategy has the benefit of minimising dependence on external markets for basic needs, it has created heavy dependence on industrialised markets for raw materials, machinery and equipment and spare parts. It is this reliance that has led to the constant under-use of available capacity in manufacturing industries in Africa: acute shortages of foreign exchange and the drastic decline in financial flows have forced cut-backs in imports of raw materials and other intermediate inputs, leaving installed plant unable to operate at its full specified capacity.

14. The way import-substitution policies and strategies have been applied in Africa has caused a wide range of economic and structural problems, including limited industrial employment opportunities; stiff competion from similar products from other developing countries, and growing demand for scarce foreign exchange to keep obsolete plant in operation.

15. Before independence many African countries used the processing of primary commodities for export as the principal basis for industrial development. It was a means of both increasing foreign exchange receipts and diversifying the structure of export earnings. Two main factors have dulled the impact of the export-led strategy. First, African countries have found it increasingly difficult to make a breakthrough in oligopolistic markets. For example, Ghana found it difficult to obtain adequate prices for its cocoa butter in a market dominated by a few chocolate producers who had their own processing capacities 6/. Secondly, because African countries are price takers in the international commodity markets, their export earnings are affected by fluctuations in world demand and also supply bottlenecks caused by quota arrangements.

16. Another industrialization strategy pursued by larger African economies was the establishment of basic industries (metals, building materials, chemicals, etc.) based on intermediate inputs produced from domestic resources as a means of providing a fully integrated industrial structure catering for domestic demand.7/ In the early development plans of Tanzania, Nigeria and Ghana, priority was given to industries such as iron and steel, cement and oil refineries. This strategy has also faltered because of a shortage of inputs for the industries selected and the demand constraints of their domestic markets.

6/ W.F. Steel and J.W. Evans - "Industrialization in Sub-Saharan Africa: Strategies and performance" World Bank Technical Paper No. 25 (1984).

7/ Y. Thomas - "Dependence and Transformation: The Economics of the Transformation to Socialism", New York: Monthly Review Press.

17. The industrial strategies and policies pursued by African countries are central to the problems of under-utilization of industrial capacity. Empirical investigation of the problem of excess capacity may well offer valuable guidance for industrial investment decisions and intervention by African Governments.

III. EXCESS CAPACITY AND STANDARDS OF UTILIZATION

18. The industrial record in Africa, especially South of the Sahara, has not matched the high expectations of industrial growth that were current at political independence. One of the main factors responsible has been the underutilization of industrial capacity. The prevalence of excess capacity in African manufacturing industries can be attributed to several factors, chief among which are difficulties in importing essential inputs and spare parts for lack of foreign exchange; demand and other market limitations; inadequate infrastructure hampering the operation of domestic distribution channels for manufactured output; a lack of skilled labour and managerial staff; and the dependence of African countries on outside sources for technology, etc.

III.1 Kinds and Causes of Excess Capacity

19. The dependence of Africa's industries on imported inputs makes output vulnerable to fluctuations in foreign exchange earnings. Shortfalls in the export earnings of many primary-commodity-dependent economies in the region, the drastic decline in external financial flows and mounting debt repayment obligations have all contributed to an acute shortage of foreign exchange which has resulted in widespread underutilization of manufacturing capacity. Ghana is reported to have experienced capacity utilization in manufacturing as low as 20-30 per cent in 1981 owing to the shortage of raw materials and spare parts. The Government is said to have imposed import restrictions because of the lack of foreign exchange resources.

20. Domestic demand and other market limitations impose severe constraints on the manufacturing sector in African economies. Most countries in the region have small populations and very low income levels. This means that, in general, purchasing power is extremely low and demand for manufacturing output is limited. There is little opportunity for export to other African countries because their similar industrial structures produce the same range of products. Additionally, the domestic markets are squeezed by cheap imports from other developing regions which offer stiff competition to locally produced products.

21. Capacity under-utilization is also partly due to infrastructural problems. Inadequate, unreliable transport facilities and frequent power cuts contribute to the under-utilization of manufacturing capacities. In Malawi, despite a 15.4 per cent growth in manufacturing output in 1983, short-term problems such as disruptions in the rail link to the ports (Biera and Nacala in Mozambique) handling the bulk of the country's external trade caused high transportation costs and delays in the flow of essential raw materials for the manufacturing sector, seriously affecting production in most industries.[8/] Since 1978,

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8/ UNECA - "Review of Economic & Social Conditions in African Least Developed Countries. 1981-1984 E/ECA/CM.11/35 E/ECA/CM.11/35.

manufacturing enterprises in Zaire have operated at only 30 per cent of capacity on average because of transport difficulties and a lack of imported inputs and spare parts.

22. The shortage of skilled labour and managerial staff is also an impediment to optimum use of manufacturing capacity. It is cited as one of the major factors accounting for why the Sudan's textile industry operated at only 25 per cent of capacity in 1982.

23. To attract foreign private capital, African Governments have designed investment incentive schemes which offer a high degree of effective protection for "infant" manufacturing industries. These incentive packages invariably include: tax holidays; duty rebates on imported raw materials and capital goods; and permission to repatriate profits and re-investible capital. As they reinforce effective levels of protection through import and foreign -exchange controls, they are detrimental to the efficient operation of the manufacturing sector, breeding monopolies which deliberately maintain idle capacity in installed plants as a means of controlling the supply and, hence, the price of locally manufactured products on the domestic markets.

24. Another plausible explanation for excess industrial capacity in developing African countries is the inadequacy of programming and follow-up of the execution of approved industrial projects. Generally, project planning does not contain norms of efficiency to be attained in the operation of the enterprise with respect to the effective utilization of inputs, productivity of labour, cost of production, maintenance of equipment, quality control, etc. This weakness could be attributed to the absence, in a number of African countries, of an appropriate institutional framework for formulating, evaluating and appraising industrial projects and to subsequently monitor the execution stage. The problem is further accentuated by the shortage of expertise in project analysis.

25. The problem of industrial capacity under-utilization also stems in part from the dependence of African countries on technology developed in industrialized countries. Plants and equipment designed for the scales of production and factor proportion prevalent in the advanced economies may well be far too large for African countries, but they are the only option available. Imported machinery thus tends to have built-in excess capacity which can only be reduced when demand grows or export possibilities are found.

III.2 Some Empirical Evidences of Excess Capacity

26. Very little attention has been given to understanding the extent and structure of excess capacity in manufacturing industries in African countries except for a limited number of country case studies. However, fragmentary evidence indicates that under-utilization of manufacturing capacities is widespread in developing Africa. As reported in the survey of Socio-Economic Conditions in Africa, 1983-1984, the problem has become so severe that the average utilization rate of manufacturing capacity is well below 50 per cent in most of the countries in the region. As stated earlier capacity utilization rates in manufacturing industries in Ghana in 1981 ranged between 20 and 30%, Zaire (since 1978: 30%) and Sudan (Textile Industry, 1982: 25%).

27. UNIDO estimates based on a survey of 48 manufacturing establishments in Burundi in 1980-1981 showed that 42 per cent of the enterprises utilized less than 50 per cent of their installed capacity. Of the private enterprises in the sample, 58 per cent utilized less than 50 per cent of capacity; the proportion for the public enterprises was 56 per cent.9/

28. A survey by the World Bank established that only half of the industries in a sample of Botswana's manufacturing sector operated at full capacity. Uganda has been unable to rehabilitate a good proportion of its national manufacturing capacity, which has been idle for over a decade; the average industrial utilization rate was estimated at 22 per cent in 1983. In Chad, most of the industrial establishments ravaged by the internal strife are yet to be rehabilitated. Of the 40 industrial enterprises located in N'Djamena (about half of the national capacity) only 13 are in operation, at capacity levels ranging from 20 to 30 per cent. Evidence from Guinea shows that the capacity utilization rate of most manufacturing industries was below 40 per cent in 1978 and has been falling ever since. Estimates for Sudan in 1980 put the average industrial utilization rate at 30 per cent; it was 20 per cent for textiles, 40.5 per cent for sugar and 53 per cent for cement.10/

29. The data in the table below indicate a considerable variation over time and between countries, ranging from an average utilization rate of 26 per cent for Ghana in 1980 to 70 per cent for Zambia in 1974-1975. The range of variation between sub-sectors within a country and between firms within a sector is even wider. All three countries show generally worsening trends during the second half of the 1970s, when economic and balance-of-payment difficulties were mounting.

9/ "Les potentiels du developpement industriel a partir des ressources naturelles dans les pays les moins avancês" - UNIDO/15.289 - February 1982.

10/ UNECA: - The Extent of Industrial Capacity Under-utilization and its impact on Industrial Development in African Least Developed Countries: Issues for consideration E/ECA/LDCs.5/4.

Table 3. AVERAGE MANUFACTURING CAPACITY UTILIZATION IN SELECTED COUNTRIES (PERCENTAGE)

Country	1967-1968	1970-1972	1972-1973	1974-1975	1976	1978	1979	1980	1982-1983	Share of subsectors with rise/fall in utilization a/ Early to mid-1970s Rise	Fall	Mid-1970s to 1980s Rise	Fall
Zambia			43	70					52	100	0	0	75
Ghana	40b/	54			44c/	40	33	26		29	57	0	100
(parastatals)						(31)	(46)	(26)				(14)	(64)
Tanzania					63			53				27	60
(Private)				(53)			(54)					(33)	(44)
(Parastatal)				(38)			(68)					(100)	(0)

Note : Unweighted averages or branches of industry averages, exept 1978-80 figures for Ghana.

a/ The difference between 100 per cent and the sum of the shares for "rise" and "fall" represents the share of subsectors that showed no appreciable changes in capacity utilization.

b/ Refers to one shift.

c/ 1975-1977

Source : W.F. Steel and J.W. Evans - "Industrialization in sub-Saharan Africa: strategies and performance" (1984) World Bank Technical Papers No. 25.

III.3 Impact of Excess Capacity

30. The level of capital stock at the disposal of an economy (industry or firm) is the main determinant not only of its current capacity to produce goods and services but also of its capacity to grow.11/ A lack of capital and inadequate capital formation, together with unemployment and underemployment of the available labour force, are typical of the countries of Africa, which can least afford the under-utilization of their productive capacities. The continued existence of excess capacity in the manufacturing sector is not only an impediment to growth in industry and hence in national output and employment, but also deters African industrialization and overall economic growth and development.

31. The problem of under-utilization of industrial capacities in the African region is further aggravated by its effects on the external payment positions and technological advancement of the countries concerned. In Africa, industrial investment is highly import-dependent because most countries cannot produce the capital goods required for the introduction of modern methods of production. Imported capital goods account for a sizeable proportion of total domestic investment: between 1965 and 1980, the volume of capital goods imported by developing Africa as a whole grew at an annual average rate of 16 per cent (at current prices). For 29 countries, imports of capital equipment accounted for about 33 per cent of total merchandize imports in 1980.

32. Machinery and equipment accounted for about 39 per cent of the total import bills of Nigeria in 1980. Tunisia has allocated 20 per cent (or 1600 million dinars) of the total planned public investment of 8000 million dinars under its development plan (1982-1986) for new investment in the manufacturing sector. Judging by figures for 1980, when 23 per cent of Tunisia's import expenditure was spent on capital goods, it is likely that a sizeable proportion of this money will be spent on equipment from abroad. Cameroon's fifth national development plan (1982-1986) also provides for new investment in the manufacturing sector of CFA 175.6 billion.

33. In Gordon Winston's case study of the Nigerian manufacturing sector, he infers that if firms were to operate at 90 per cent of their targeted capacity, manufacturing employment would increase annually by over half the amount estimated in the third national development plan (1975-1980), for which a projected N1.5 billion in new investment was earmarked.12/ In other words, a considerable amount of the investment envisaged by Nigeria could have been diverted to other projects if measures were adopted to reduce capital wastage in the manufacturing sector.

11/ Meir Merhav - "Excess Capacity - Measurement, Causes and Uses: A Selected Case Study in Israel" - UNIDO: Industrialization and Productivity Bulletin No. 15, UN, 1970.

12/ G.C. Winston - "Increasing Manufacturing Employment Through Further Utilization of Capacity in Nigeria" - Research Memorandum Series No.67 - Centre for Development Economics, William's College, Williams Town, Massachusetts.

34. The effects of under-utilization of industrial capacity on technological progress are equally detrimental to industrial development. The under-utilization of machinery and equipment prolongs the life-span of installed capacity and hinders the replacement of obsolete equipment with the more advanced production methods used in the machinery available in advanced countries. If Africa is, technologically speaking, the world's most backward region, its surplus of industrial capacity is one of the reasons for this dubious distinction.

IV. CONCEPTUAL ISSUES IN MEASURING UNDER-UTILIZATION OF CAPACITY

35. The concept of capacity utilization and its measurement has been subjected to a wide range of alternative definitions, interpretations and misconceptions. In its application to the analysis of productive capacity utilization, especially in African economies, it is first necessary to be clear about the distinctions between capacity and capital utilization and the various levels of analysis (macro and micro) so that utilization measures can be properly applied in policy and industrial investment decisions.

IV.1 Capacity and capital utilization

36. Capacity utilization (in the "broad" sense which includes capital) is the measure used to describe the state of affairs when, for one reason or another, an industry (or economy, etc.) is unable to make full, sustained use of its available resources to produce the intended or desirable level of output. 13/ Capital utilization, on the other hand, describes how much of the time an industry's (or economy's) productive capital stock is utilized in a given period and how much of the time it remains idle.

37. There are, therefore, two broad approaches to the measurement of capacity utilization - one that concerns the extent of utilization of capital only, and the other that relates to the degree of utilization of all available resources (capital, labour, land and other materials). The engineering concept of capacity utilization falls in the former category, and defines the maximum output that can be produced using a given plant and equipment. This is purely a technical concept, but it highlights a significant difference between the engineer and the economist, because what may be technically feasible for a plant of a given size may not necessarily be economically desirable owing to cost constraints and other limitations.

IV.2 Macro- and Micro-Capacity

38. The distinction between macro- and micro-analysis of capacity utilization may be highly elusive because the terms are associated with a number of different concepts and methods of measurement. Macro-capacity is a general equilibrium concept based on the notion of aggregate productive capacity: The maximum sustainable level of output that can be derived in a year when all the available

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13/ A. Fabayo: "An Economic Analysis of Productive Capacity Under-utilization in some Nigerian Manufacturing Industries" Quarterly Journal of Administration, University of Ife, July, 1981.

resources in an economy are fully and efficiently utilized at a given level of technology. Such economy-wide measures of capacity are usually referred to as the "output gap", representing the degree of underutilization of all resources, not only capital. In the majority of developing countries, particularly in Africa, such assumptions of "full" and "efficient" use are misleading and may lead to distortions in policymaking and to wrong investment decisions.14/

39. In fact, the main areas of application of "aggregate productive capacity" are in analysing the demand for investment and the real causes of demand-pull inflation; explaining variations in trade flows, and analysing changes in factor productivity over the business cycle. Applications of these capacity measures have been confined mainly to industrialized economies.

40. At the micro-level, the divergence of approach to the measurement of capacity from the engineering and economic standpoints must be made clear. The engineer's concept involves "practical capacity", which is defined as the maximum output that is possible given a fixed plant and equipment under realistic operating conditions allowing for normal machine maintenance, assuming no stoppage due to major breakdown, and expecting reasonable productivity from the labour force.15/

41. To the economist, cost is a very important element in the production process; he therefore defines capacity as the maximum possible output in a given period at the minimum average cost per unit of output. In African countries, the rhythmic nature of the availability of inputs at widely fluctuating prices, variations in the types and qualities of materials available for processing and the low productivity of labour mean that the average firm's level of economic capacity may be significantly below the maximum output assumed by the engineer. Here, also, the researcher should be careful in measuring and applying utilization measures in African countries.

42. However, we have oriented this study to propose a methodology in the context of micro-capacity (at the plant level) since the intention is to demonstrate the extent of excess capacity in African manufacturing industry and to devise appropriate techniques for measuring capacity utilization. The manufacturing sector has been chosen not only for its relative homogeneity of inputs and outputs but because the sector is a major thrust in development strategies of African countries and hence the need to institute mechanisms to prevent the waste of expensive capital in industrial development.

14/ For a better understanding of the application of such analysis, see: G.C. Winston "Capacity: - An integrated micro and macroanalysis" The American Economic Review - vol. 67, February 1967.

15/ Gul Alfred and Dilip Roy - "Capacity utilization in selected manufacturing industries of Bangladesh" - The Bangladesh Development Studies 4 (2) April, 1976.

V. MEASURING EXCESS CAPACITY: A PROPOSED METHODOLOGICAL FRAMEWORK FOR AFRICAN COUNTRIES

43. Interest in the utilization of existing capital, plant and machinery first awoke in the Western industrialized countries where policy-makers were concerned with the Keynesian cyclical deviation of output from the desired level. Although the problem of under-utilized industrial capacity is widespread in the African region, there has been very limited research on the subject in African countries (with the notable exceptions of Nigeria, Morocco, Burundi, Kenya and the United Republic of Tanzania). The value of studies on capacity utilization in developing countries, especially in Africa, where capital is not only scarce but extensively under-utilized, can hardly be over-emphasized because the level of capacity utilization not only indicates how much more output could be obtained by making full use of existing capital but can also define the expansion of capacity required to reach targetted output without embarking on superfluous investment.

44. Various techniques for measuring the degree of capacity utilization have been developed and applied in a number of countries, including those in Africa, and found useful in policy analysis and industrial investment decisions. A selected number are reviewed below. to provide a basis on which a methodological framework adaptable to the African conditions will be proposed.

V.1 Review of Methodologies for Measuring Excess Capacity

A. Capital/output Ratios

45. This measure relies on the assumption that there is a stable, proportional relationship between the level of capital stock and potential output.16/ It ascribes fluctuations in the observed capital/output ratio largely to deviations in output from its potential. In a nutshell, the method consists of choosing a base period in which it is assumed that full capacity output was obtained; the value of the capital stock available is expressed in ratio to estimated base-period capacity output. This measure is regarded as the basic capital/output ratio. In order to use this ratio to estimate capacity utilization in subsequent years: net additions to capital stock over time are added to the base-period capital stock, or the value of existing capital stock is directly measured; the ratio of this new capital stock value to the actual new output is obtained and the basic capital-output ratio is expressed as a percentage of this new current output ratio to yield a current rate of capacity utilization.

46. Phillips' criticisms of the application of this method in developing countries are that, firstly, it may be impossible to specify a historic point at which capital output ratios reflect capacity utilization, and capacity output may have to be independently estimated before good measures of utilization rates

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16/ For a detailed illustration, see M. Panic - "Capacity utilization in U.K. manufacturing industry" - Discussion Paper No. 5 - National Economic Development Office (1976).

can be obtained 17/ Secondly, the findings may not throw light on the reasons for the low intensity of use of capital goods: in other words, analysis of capital output ratios alone will not yield the type of policy-oriented information needed in developing countries.

B. The Wharton School Method 18/

47. This approach is called the Trend Through Peaks method, by which an attempt is made to measure the degree of utilization of all inputs. In applying this method to the manufacturing sector, a level of disaggregation is introduced through the use of historical output rates (seasonally adjusted) for each of several manufacturing industries. It is assumed that the major peaks in the series represent output where all inputs are utilized at 100 per cent of capacity. A linear interpolation between major output peaks is made, and the utilization rates calculated are the ratios of actual outputs to the corresponding points on the line. Forward extrapolation of the line yields a measure of current full capacity output up to the point where actual current output crosses the extrapolated line.

48. A major drawback to applying this method in developing countries is that there is seemingly no great need for data to measure output losses that result only from insufficient aggregate demand. Cyclical phenomena are not of great importance, nor are indications for output rates at which induced investment occurs, especially valuable. Hence, peak outputs will not be true capacity outputs. Infact, Christiano argues that capacity figures obtained since the most recent peaks are subject to substantial revision when a new peak occurs. If projected capacity growth is greater than actual capacity, the computed capacity utilization rate trends increasingly downwards; it tends to rise if projected capacity is less than actual capacity growth.19/ Thus capacity utilization figures computed using the Wharton School peak-to-peak method will be unreliable.

17/ A Phillips - "Measuring industrial capacity and capacity utilization in the developed countries" - UNIDO - Industrialization and Productivity Bulletin, No. 15, UN (1970).

18/ For details, see L.R. Klein and R. Summers - "The Wharton Index of Capacity Utilization" - Wharton School of Finance and Commerce (Philadelphia, 1966).

19/ L.J. Christiano - "Survey of Measures of Capacity Utilization" IMF Staff Papers, vol. 28, No.1 (March 1981).

C. The Engineering Approach

49. In certain cases, capacity utilization rates can be measured using direct engineering estimates. The method was adopted by Alfroz and Roy in measuring the rates of capacity utilization in manufacturing industries in Bangladesh. In this case, capacity is defined as the maximum outflow which could be achieved from the installed capital stock in a given period, whereas utilization means the actual amount of capacity which has been employed to get output in the same period. The degree of capacity utilization is then defined as the ratio between actual utilization and the potential capacity of any plant (see Annex III for details of the mathematical relationships).

50. A crucial defect of this approach is that direct engineering estimates are not very useful for the larger problems of developing countries owing to the relatively low amount of economic activity about which enough is known to specify engineering production functions. The mere knowledge of a physical production relation will not reveal the reasons underlying low utilization rates in developing countries, which involve more complex factors.

D. Other techniques

51. The McGraw-Hill approach is a survey-based method which estimates capacity utilization based on general questions concerning, among others, the physical volume of output; the percentage of "full capacity" that plants were operated and their prefered level of utilization.[20/] This is a subjective measure since the survey does not provide a standard definition for full capacity, actual operating and prefered operating rates and their treatment at cross purposes by respondents may breed a number of estimation biases and invariably result in gross underestimation of capacity utilization. However, the measure is useful as a first approximation in an operational sense since managers of enterprises are the ones who make investment decisions and their assessment of capacity utilization determines either an intensive utilization of factor inputs or the infusion of new investment.

52. The Shift-measure is another method of measurement which takes into account the actual number of shifts worked per day expressed as a percentage of the capacity number of shifts per day. According to KABAJ, [21/] the simplified coefficient of extensive capacity utilization (Cu) can be expressed as follows:

$$Cu = \frac{S}{So}$$ where S is the actual number of shifts worked (or shift coefficient) and So is the optimum or desirable shift coefficient.

The shift coefficient is expressed as a ratio between the total number of man-hours worked and the number of man-hours worked in the first shift i.e.

20/ For a detailed description and use of this method, see the 25th Annual McGraw-Hill Survey, April, 1972, Department of Economics, MCGraw-Hill Publishing Company.

21/ M. Kabaj- "Utilization of industrial capacity - shift work and employment promotion in developing countries" - Industrial Capacity and Employment Promotion, ILO, 1981. Also see W.P. Hogan - "Capacity creation and utilization in Pakistan" - Australian Economic Papers, June, 1968.

$$S = \frac{Eh_1 + Eh_2 + Eh_3}{Eh_1} = \frac{Eh}{Eh_1}$$

where Eh_1, Eh_2, Eh_3 are the number of man-hours worked on the first, second and third shifts respectively and Eh the total number of hours worked [see Annexes III(a) and III(b)].22/

53. A major draw back for the application of this method in developing countries is its complete emphasis on labour input which is relatively abundant as opposed to capital, which is scarce. Hence there would be an underestimation of capacity utilization for the plant as a whole when all factor inputs are taken into account. Also, the fact that capacity number of shifts is not standard among establishments in a country may pose an aggregation problem at the industry level.

54. The Electricity measure is based on the premise that since electricity is the main source of energy in modern industry, if we can find the intensity of usage of electric motors which drive the machinery, then one can estimate approximately the intensity of usage of the machinery.23/ Computationally, the utilization rate (Uit) is defined by the ratio of actual consumption of electricity (Kwh) to the maximum possible consumption by installed electric motor which is given under the assumption that they are operated continuously without any interruption during a given period. Algebrically, $U_{it} = [E^m_{it} / (C^m_{it} \times 8760/0.9] \times 100$, where U_{it} is the electric motor utilization rate of plant i in year t; E^m_{it}, actual consumption of Electricity (Kwh) by motors of plant i in year t, C^m_{it} is the rated capacity of installed electric motors (Kwh) of plant i in year t, 8760 is the total number of hours in a year and 0.9 is the efficiency of electric motors on the assumption that 10 per cent of power input into the electric motors is dissipated in the form of heat.24/

55. A fundamental flaw in this method is that different sections of plants especially in developing countries, may be operated by other movers such as steam engines and turbines, gasoline engines, etc., and the lack of a proper system of weights for sections with different capital values could yield significant underestimation of capacity utilization. Other sources of underestimation include the shortage of data on the composition of electricity consumption in developing countries; the fact that not all electricity-using machinery is designed to be operated simultaneously; and the assumption of continuous and uninterrupted operation of the plant for 8760 hours, since time has to be set aside for compulsory holidays, repairs and maintenance.

22/ This is one of four basic approaches developed by Kabaj for the measurement of shift coefficient.

23/ The electricity measure was developed by Foss to measure capacity in U.S. manufacturing - see Murray F. Foss - "The utilization of capital equipment: Post-war compared with Prewar" - Survey of current business, June, 1963.

24/ For the use of this methodology, see Y.C. Kim and J.K. Kwom - "The utilization of capital and the growth of output in a developing economy: The case of South Korea manufacturing" - Journal of Development Economics,4 (1977).

V.2 A Proposed Methodological Framework for Africa

56. Experience of the African industrial environment suggests that, the most appealing method of estimating industrial excess capacity in African countries is the survey-based or direct enumeration approach. Phillips has noted that in developing countries "... the method of direct enumeration is the most hopeful of all the approaches but one which must be employed carefully". One obvious advantage, he argues, is that with the survey method, direct questions relating to capacity are responded to by persons likely to know the answers.25/

57. Simply, the survey method entails the design of an unambigious questionnaire, which the researcher employs through direct interviews with plant managers, on the extent to which factor inputs, particularly capital, are used by their establishments. Most especially, questions are asked on the available level of capacity and the obstacles to attaining the desired level of output. This method has been successfully applied in a number of African countries with very interesting results, which may enable governments and enterprise managers to stem the growing tide of the wastage of resources.

58. To utilize the data obtained from the Survey (see attached questionnaire) in measuring capacity utilization rates in the manufacturing sector of African countries, it is proposed to employ a combination of both the McGraw- Hill measure (U_m) described above, with the assumption that full capacity is associated with a given capital stock; and the Winston-time-measure (U_t) which gives the number of hours a plant is operated in a year as a percentage of 8760 hours (i.e. 24 x 365 days).26/ The underlying assumption for this suggested approach is that all variations in utilization of plant and equipment take the form of variations in time (i.e. in operating schedules) since these schedules, in the context of African manufacturing establishments, tend to remain close to standard and normal hours that would generate the plant's full capacity output.

59. By way of illustrating this technique, one should start by interpreting U_m in terms of time for a typical day of operations. Given that HT refers to 24 hours in a day, HA is the actual number of hours the plant is operated, HE, the plant manager's estimate of the full capacity equivalent number of hours, and HD as his desired number of hours of operation per day, then

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25/ A. Phillips - "An appraisal of measures of capacity" - American Economic Review - Papers and Proceedings. vol. 53 (May, 1963).

26/ It should be noted that the assumption of a 8760 hours of continuous and uninterrupted operation is relatively unsatisfactory since time has to be set aside for repair and maintenance and that the time requirement varies between industries and between firms within the same industry if different techniques of production are used.

$$U_m = \frac{HA}{HE} \quad \text{and} \quad U_t = \frac{HA}{HT}$$

To obtain the McGraw-Hill measure of the enterpreneur's estimate of full capacity in terms of time,

$U_{fm} = \frac{HE}{HT}$, representing the installed capacity of the plant.

From these results, we then calculate the desired level of capacity utilization in terms of time as:

$U_{dt} = \frac{HD}{HT}$, which is interpreted as the economic capacity of the plant. The difference between U_{fm} and U_{dt} will indicate the Extent of Excess Capacity in the Plant. Generally, U_{dt} is lower than U_{fm}. In the case where a plant consist of different sections that run differently, the share of each section in the total replacement value of the plant should be used as weights in calculating the capital utilization of the entire plant.27/

V.3 Overall Data Requirements

60. The main intention for delving, to some extent, into the conceptual issues and definitional problems in measuring industrial capacity utilization in section IV of this paper, is to provide a basis for a clearer understanding of the problem and to ensure adequate coverage and quality of the data as this is highly correlated with the scope of the surveys to be conducted. In most African countries, nation-wide industrial surveys are either nonexistent or carried out on an ad-hoc basis. The questionnaires designed are usually inadequate for the purpose of determining the Extent of Excess Capacity in the Manufacturing Sector. The coverage is generally limited and do not even cover such important indicators as industrial production by product, capital formation by type of capital goods, workdays, materials consumed by nature, etc., which are the basic data requirement for proper analysis of the industrial sector. These problems are compounded by the lack of specialized staff in the field of industrial statistics.

61. In the context of the above shortcomings, an attempt has been made to re-structure and modify a capacity utilization survey questionnaire developed and used by Gordon Winston in a case study on "increasing manufacturing employment through further utilization of capacity in Nigeria" (see Annex IV). The draft questionnaire is self-explanatory, and fully covers the data that will be required to launch

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27/ See David Lim - "Actual, desired and full level of capital utilization in Malaysian manufacturing" - Journal of Development Studies, 14(1), October, 1977. Also, G.C. Winston - "Capital utilization in economic development" - Economic Journal, 1971.

research on the under-utilization of capacity in manufacturing industries in Africa. In addition to other associated factors, interviews should elicit information on (i) the characteristics of the plant's product line, plant size and life span; (ii) scale and working capital; (iii) the level of utilization, both in terms of time and intensity of use of factor inputs, and the pattern of utilization in a given period; (iv) factors related to labour and productivity; (v) market structure; and (vi) overall utilization of the capacity of the plant.

VI. RECOMMENDATIONS AND CONCLUSIONS

VI. 1 Recommendations

62. It has been amply demonstrated that excess capacity is a widespread phenomenon in the manufacturing sector and one of the main reasons for Africa's slow industrial growth. The prevalence of excess capacity can be attributed to the following main factors; (i) difficulties in importing essential inputs and spare parts, due to an acute shortage of foreign exchange; (ii) demand and other market limitations, which include the lack of export possibilities and stiff competition from imports; (iii) inadequate infrastructure, frequent power failures and shortages of other utilities; (iv) a lack of skilled labour, managerial and supervisory staff and (v) heavy dependence on advanced countries for technology.

63. The shortage of foreign exchange to buy essential inputs is the major reason for the persistence of excess capacity in most African countries. Governments should take measures to ensure that domestic credit conditions and allocations of foreign exchange for imported capital equipment, raw materials and spare parts reflect existing market conditions.

64. Demand and market limitations can be circumvented by African countries if their Governments will pursue a subregional and regional approach to industrial programming and planning and, whenever feasible, to the joint financing of core industrial projects.

65. With respect to infrastructural problems, including utility supply, (especially of electricity) to manufacturing establishments, Governments and/or managers of manufacturing enterprises should endeavour to establish strategic distribution points for manufactured products and ensure that adequate transportation facilities are available for the free flow of essential inputs. Inefficient public utility corporations should be overhauled and turned into self-financing commercial enterprises providing reliable services at competitive rates.

66. The shortages of skilled labour, managerial and supervisory personnel are often specific to certain countries and occupational groups: skills in short supply in one country may be underemployed in another. African Governments should endeavour to exchange skilled labour within an ECDC or TCDC framework and identify specialized institutions in the region to train manpower for the industrial sector. At the national level, Governments could establish skills centers with the use of technical assistance provided for industrial development; any such undertaking must of course be preceded by a detailed inventory of the skills required and a realistic forecast of how the staff trained would subsequently be deployed in the industrial sector.

67. The best means of escaping the "technology-trap" would be through subregional and regional co-operation. At the plant level, managers of industrial enterprises should arrange periodic checks on production facilities to detect maintenance problems. Obsolete machinery must be replaced with more efficient equipment and modern production methods.

68. In view of the statistical problems discussed earlier, African countries should endeavour to organize and conduct nation-wide industrial censuses in order to establish a comprehensive register of manufacturing establishments containing information on key indicators for ascertaining the structure and performance of the industrial sector. More importantly, industrial surveys should be conducted on a regular basis (preferably every quarter) and a section in the questionnaire specifically devoted to capacity utilization since investment decisions are subject to seasonal and other short-term changes in employment and output.

VI.2 Conclusion

69. The study has been intended to serve the following purposes: Firstly, it is to demonstrate the extent of industrial capacity underutilization in African countries and to acquaint the Planners and Statisticians with the main causes of excess capacity and its impact on industrial growth. Secondly, it is the intention to familiarize Planners and Statisticians with the current status of research which has created a clearer understanding of this dimension of productive efficiency and its significance for capital productivity and other factor inputs. Such an understanding will substantially improve planning efforts, particularly with regards to the kinds and usefulness of data to be collected on capacity utilization.

70. A third purpose, as illustrated in Section V of this paper, is to encourage the use of coherent methodologies in the measurement of capacity utilization and the measures to be taken for the generation of statistical data and other technical information required for the study of the problem of excess capacity. We hope that the study has attained these objectives and therefore recommend that actions be taken, including the recommendations herein, so as to increase capacity utilization in the manufacturing sector and pave the way for an accelerated industrial development of countries in the region.

Annex I

Actual and intended capital utilisation and business capacity utilisation in manufacturing industries in Nigeria and Morocco based upon surveys of 50 firms

Average	Actual capital utilisation, section and intensity adjusted as a percentage of 8,760 hours		Actual capital utilisation as a percentage of intended utilisation		Intended utilisation as a percentage of 8,760 hours		Business capacity utilisation in terms of output (McGraw-Hill)	
	Nigeria	Morocco	Nigeria	Morocco	Nigeria	Morocco	Nigeria	Morocco
Unweighted	36.4	31.6	76.8	74.5	47.4	42.3	68.8	60.6
Weighted by capital	70.6	46.7	92.0	85.6	76.7	54.6	83.0	58.2
Weighted by employment	55.9	29.4	94.4	72.1	59.2	40.7	83.1	66.7

Source: Industrial capacity and employment promotion, ILO, 1981.

Annex II (a)

Calculation of shift coefficients for workers in different factories

Factory	No.of Workers	No.of workers working during			No.of man-hours per shift	No.of working days per year	No.of man-hours per year worked during ('000s)			Total no.of man-hours worked per yr ('000s)	Shift coefficient
		First shift	Second shift	Third shift			First shift	Second shift	Third shift		
A	900	500	300	100	8	300	1 200	720	240	2 160	1.80
B	500	300	200	-	8	300	720	480	-	1 200	1.67
C	250	100	100	50	8	300	240	240	120	600	2.50
D	200	200	-	-	8	300	480	-	-	480	1.00
TOTAL	1 850	1 100	600	150	8	300	2 640	1 440	360	4 440	1.68

Source: M. Kabaj - "Utilization of industrial capacity-shift work and employment promotion in developing countries" - Industrial capacity and employment promotion, ILO, 1981.

Annex II(b)

Calculation of shift coeficients for different types of equipment

	Types of equipment	No.of units	No.of machines working during			No.of machine-hours per shift	No.of working days per year	Total no.of machine-hours working per year ('000s)			Total no.of machine-hours worked ('000s)	Shift coefficient
			First shift	Second shift	Third shift			First shift	Second shift	Third shift		
Factory A	Machine tools	100	100	50	50	8	300	240	120	120	480	2.00
	Stamping and pressing equipment	50	50	20	10	8	300	120	48	24	192	1.60
Total		150	150	70	60	8	300	360	168	144	672	1.87
Factory B	Machine tools	200	200	-	-	8	300	480	-	-	480	1.00
	Stamping and pressing equipment	100	100	-	-	8	300	240	-	-	240	1.00
Total		300	300	-	-	8	300	720	-	-	720	1.00
Factory A and B	Machine tools	300	300	50	50	8	300	720	120	120	960	1.33
	Stamping and pressing equipment	150	150	20	10	8	300	360	48	240	432	1.20
Total		450	450	70	60	8	300	1 080	168	144	1 392	1.29

Source: M. Kabaj - "Utilization of industrial capacity-shift work and employment promotion in development countries" - Industrial capacity and employment promotion, ILO, 1981.

Annex III

An illustration of the engineering approach

Referring to paragraph 49 ALFROZ and ROY* have used the following proxy to estimate capacity utilization rates:

Degree of capacity utilization (C_u) is defined as the ratio between actual utilization and potential capacity of a plant:-

$$C_u = \frac{A}{C}, \quad \text{Where } A = \text{Actual annual production and}$$
$$C = \text{Annual maximum output}$$

Capacity utilization can be written otherwise as:

$$C_u = \frac{A}{T.X_k}, \quad \text{Where } X_k = \text{hourly output at 100\% efficiency}$$

T = the period of observation (8 760 hours = 365 x 24)

$T.X_k$ is the theoretical maximum output. But, practically, it is not possible neither to work a machine for 24 hours of 365 days nor to obtain 100% efficiency. So in order to obtain the technically feasible capacity, t is considered which gives the maximum feasible hours instead of the theorotical number of hours, T. X_k, the hourly output at 100% efficiency level, is an engineering maximum which cannot be obtained due to the wastage in process, machine break-down, lack of proper labour attention and supervision, and other related conditions. Therefore, a proxy, a, considered to be feasible under these operating conditions is chosen. For the study, ALFROZ and ROY considered 75% as a feasible economic maximum for Bangladesh based on the views of experienced managers and of experiences in other countries like INDIA.

Hence, the degree of utilization of technical capacity can be written as:

$$C_F = \frac{A}{t.\ aX_k},$$

Where C_F = feasible capacity utilization rate

A = actual annual output

t = feasible maximum number of hours that can be worked during T

a = proportion of X_k considered attainable under normal operating conditions

X_k = hourly output at 100% efficiency level.

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* G. Alfroz and D.K. Roy - "Capacity utilization in selected manufacturing industries in Bangladesh" - The Bangladesh Development Studies, vol. 2, April, 1976.

The measure of capacity utilization is calculated on the basis of t (feasible maximum number of hours) that can be worked. If one is interested to know the extent of utilization on the basis of actual number of hours worked i.e. to what extent it has utilized the time it has worked, the measure can be written as follows:-

$C_A = \frac{t'}{t} . aX_k$, Where t' = actual number of hours worked.

Annex IV

DRAFT QUESTIONNAIRE FOR INDUSTRIAL CAPACITY UTILIZATION SURVEY IN AFRICAN COUNTRIES*

1. Enterprise profile

1.1 Name of Enterprise: _____

1.2 Address of plant: _____

1.3 Respondent(s) Name(s) and Title(s): _____

_____

1.4 Was a feasibility study undertaken prior to the estblishment of the Enterprise?

1.5 Enterprise ownership: public/ private/ mixed
domestic/ foreign/

1.6 Top management of enterprise in (country): domestic/ foreign/

2. Plant characteristics

2.1 Product(s):

Product _____ total sales _____
value of exports _____

Product _____ total sales _____
value of exports _____

2.2 Size of plant:

Total number of production employees _____
Value of assets _____
Annual sales volume _____
Value added _____

2.3 Age of plant [making present product(s)]:

First built (date) _____
Last major expansion (date) _____

2.4 How many other plants (in country) owned/operated by your enterprise?

_____

How many produce same product(s) ? _____

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* The present format of this Questionnaire is a re-structured and modified version of the "Capacity utilization survey questionnaire" developed and used by Prof. Gordon C. Winston for a case study on "Increasing manufacturing employment through fuller utilization of capacity in Nigeria" - Research Memorandum No. 67 - The Center for Development Economics, Williams College, Williamstown, Massachusetts.

3. The level of utilization - time

3.1 How many full working days was the entire plant idle during the last calandar year? _____ [report all days plant was idle including weekends, holidays, time for maintenance and repairs]

3.2 So you operated at least a part of the plant during [365 minus the answer above] days ? _____ (yes/no) [This is a check question]

3.3 During the typical operating day, you ran some part of the plant for _____ hours?

3.4 During how many Saturdays in the year did you operate at least part of the day ? _____

3.5 How many hours did you typically operate when you operated on Saturdays ?

_____

4. The level of utilization - intensity

4.1 During operation, how much of the entire plant is typically in use? _____ (%)

4.2 Do you operate different parts of the plant ["sections"] a different number of hours per days? (yes/no) _____

4.3 Do you typically operate different parts of the plant a different number of days per year? (yes/no) _____

If the answer to 4.2 or 4.3 is "Yes" complete question 4* for each section of the plant that operates a different schedule

4*. The level of utilization - separate plant sections

This portion describes the _____ section

4*.1 How many days was the entire section idle during the past calendar year? _____ (days)

4*.2 So at least part of the section operated during [365 minus the answer to 4*.1] days? _____

4*.3 So in a typical operating day, some part of the section operated for how many hours? _____

4*.4 During operation, how much of the section is typically in use?_____ (%)

4*.5 What proportion of the plant does this section represent _____ (%)

5. The pattern of utilization over the year

5.1 Over the typical year, are there regular patterns of greater or lesser production? _____ (yes/no)

5.2 When? _____

5.3 By how much does production vary over those patterns (% re-average)? _____

5.4 Why? _____ Demand variations? (how much, regular, random) (markets? prices?)
Supply (input) variations: (availability? price?)

5.5 Does the plant have periods of full shut down? _____ (yes/no)
Did you include that in estimating idleness above? _____
(If not, correct those figures as appropriate)

6. Hours of work

6.1 How many hours per day does a production worker typically work?
_____

6.2 How many days per week does a production worker typically work?

6.3 How many weeks per year does a production worker typically work?
_____

7. Labor payments - wages and shift premia

7.1 Is a production worker typically paid
- For the number of hours he works? _____ or
- For the number of days, weeks or months? _____

7.2 Wage rate of production workers are, on the average, US$ _____
(per hour (day shift), day, week, month) 1/

1/ Wage rate should be stated in National currancies.

7.3 Are production workers typically paid a higher wage for working:

- during nights? _____(amount or % over day rate)
- during weekends/holidays? _____(amount or % over week day rate)
- overtime, after a normal work day or week _____(amount or % over day rate)

7.4 Do you pay other costs for labor

food? _____(per worker per day or as % wage rate)
transport? _____ (per worker per day or as 5 wage rate)
medical? _____ (per worker per day or as % wage rate)
Other (specify) _____

8. Labor and productivity

8.1 How many production workers are at work in the plant during a typical day shift? _____
night shift? _____
3rd shift _____

8.2 Is output per man-hour.

(a) higher for day work? _____
(b) higher for night work? _____
(c) higher for 3rd shift? _____
(d) about the same for all? _____

9. Capacity and utilization

9.1 At what percent of full capacity did you operate last year _____(%)

9.2 What would you consider to be a desirable "standard" or "normal" workweek for the plant? _____(hours of operation per week)

9.2.1 Would this be "full capacity" operation? _____ (yes/no)

9.3 Realistically, do you think you could regularly produce more output with your existing plant, labor force and hours of work? _____ (yes/no)

9.3.1 If yes, how much more? _____ (%)

9.3.2 If yes, what would be different about your production?

_____

9.4 If you added a 2nd (3rd) shift:

9.4.1 Would you use more/fewer workers than on 1st shift?
_____% more/fewer
Why? _____

9.4.2 Would you expect to get the same output shift as you do now on 1st (2nd) shift: _____% more/less Why? _____
_____

9.4.3 Would you need more equipment or plant?
_____% more (re-value of present)
Why/what for? _____

9.4.4 Would you need more working capital?
_____% more (re-present)
What for? _____

9.5 When you change production levels, do you change the time you run the plant? _____
change the labor crew size? _____
neither? _____

9.5.1 If you increase time, do you add hours to existing shifts (work overtime)? _____
add shifts (new workers)? _____
add work days/week? _____
other _____

9.5.2 Why? _____

9.6 By how much would you increase output (employment) if you had (at existing prices) adequate:

		Output	Employment
9.6.1	Power? Water? [Do you have Generator?]	_____%	_____%
9.6.2	Imported raw materials?	_____%	_____%
9.6.3	Imported spare parts?	_____%	_____%
9.6.4	Domestic raw materials?	_____%	_____%
9.6.5	Supervision?/technical personnel?	_____%	_____%

		Output	Employment
9.6.6	Other constraint (specify _____)?	_____%	_____%
9.6.7	Demand for output?	_____%	_____%
9.6.8	All of the above?	_____%	_____%

10. Market structure

10.1 How many domestic firms do you compete with in selling your product(s)? _____

10.2 How many are larger than your firm? _____ (number); smaller? _____ (number)

10.3 Is your product(s) faced with competion from similar product(s) imported into the country? _____

10.4 Specify the main origin of the product(s) _____

11. Scale and working capital

11.1 Was the plant originally built too large for the existing market? _____(yes/no)
BY how much? _____(%)
How many years was the plant expected to reach full capacity output? _____

11.2 If you knew you'd continue to produce at levels of the past year, would a smaller plant (larger plant) be more economical? _____ _____ (yes/no)

11.2.1 Have you ever worked shifts? _____

11.2.2 How do you feel about it? _____

11.2.3 Would you change shifts worked? _____ (yes/no)

11.2.4 Would you change level of employment? _____ (yes/no)

11.3 Do you expect your output to grow? _____ (yes/no)

11.3.1 By how much over a period of 5 years? _____ (%)

11.3.2 Will you change shifts worked? _____ (yes/no)

- Will you change size of employment _____(yes/no)
- Will you expand plant or equipment _____ (yes/no)

11.3.3 Would your answers (to 11.3) be different if interest rates or the price of construction and equipment were to double relative to all other prices? _____ (yes/no)

How? _____

11.4 Is working capital available on same terms (interest, rationary) as fixed capital? _____ (yes/no)

Difference: _____

12. Free association - unstructured responses to

Ask: quality
Unexpected competition
Foreign competition
Impact of licences for inputs on capacity
Shipment delays of spares
Other: